Illinois

Summer 1990 Volume 105, Issue 4

Technograph

ENGINEERING

A HEALTHIER

EDITORIAL

The 80's and the 90's have seen an increasing consciousness of the American public about health. Not only health of the body, but also health of the mind (psychiatric evaluations), and academic health (more children are going to college now than in the past). Finally, we are seeing a consciousness of the environment.

With the popular slogan " Think Globally, Act Locally," environmental activist groups are now taking a prominent place in getting Americans to improve the health of their environment.

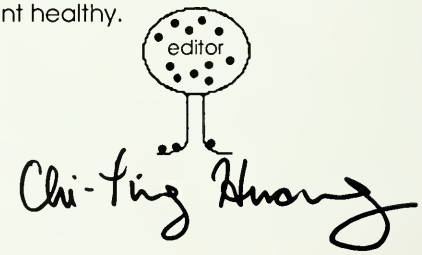
At the University of Illinois, this is especially noticeable in the many waste recycling stations around campus. In the university housing as well, many students have begun a separate waste recycling project of their own. In fact, so much is being recycled, that many of the recycling centers in Urbana are near full capacity.

Recycling is one of the major steps toward smaller landfills and less garbage. Chicago residents will soon be required to separate their garbage and many other cities require lawn or organic wastes to be separated from ordinary household garbage.

Biodegradable materials are also a hot topic in environmentalism. The current "biodegradable plastics" are not really biodegradable in the plastic sense. Most of these plastics are made of cornstarch and regular plastic so that the cornstarch biodegrades but not the plastic itself; it just disintegrates into tiny plastic pieces rather than one big piece of plastic. Other concerns are that biodegradable materials may not necessarily biodegrade if they are not exposed to the proper conditions. One garbage landfill was found to contain dried carrots and old newspapers that had not degraded at all since the landfill did not contain enough moist organic matter.

In order to promote a better environment, many engineers are taking environmental courses. There is even an engineering curriculum called environmental engineering which is administered through civil engineering. A student who wished to get an environmental engineering degree would have to major in civil engineering and get a specialization in environmental. It is not necessary, however, to be a civil engineer first. Many students enrolled in the chemistry curiculum pursue the environmental engineering degree in graduate school.

Americans are becoming more health conscious, and one of the best ways to remain healthy is to keep the environment healthy.



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Earth Day Turns Twenty

April 21, 1990 will see one of the largest demonstrations in University of Illinois history. This day will be a part of the celebration of the twentieth anniversary of Earth Day. Much of the planning for the events during the week of April 16 has been done by Students for Environmental Concerns (SECS). SECS has support from over forty student groups and twenty University departments. Activities related to Earth Day have already begun and will continue through April 22.

The first nationally organized Earth Day occurred on April 22, 1970 and promoted ecology and a heightened awareness of the environment. From this first celebration, the EPA was formed and the first clean air and water bills were written. In addition, SECS was founded at the University as a way to maintain an awareness of the environment through both education and action. Since then, SECS has been one of the most effective direct-action groups in the community, initiating and implementing the first recycling program ever at the University, playing an instrumental role in compelling Abbot Power Plant to install scrubbers at their facility, and conducting numerous letter-writing campaigns for environmental issues. Some recent activities of SECS include a recycling drive and tree planting with REM and Star Course, a semi-annual phone book recycling drive, and the student rally for environmental change which drew over 800 people.

During the week of Earth Day (April 16-22), SECS has prepared programs which will combine action, education, and entertainment in the name of heightening the community's awareness of environmental issues. There will be ecology tours to five areas of interest (the recycling center and Allerton Park are two of the five), educational booths, lunch and dinner seminars with faculty and community speakers, and radio and television interviews. Monday through Thursday night there will be speeches by five nationally recognized speakers. Monday night, Nick Lenssen of the World Watch Institute and Ted Flanigan, Energy Program Director of the Rocky Mountain Institute will be speaking on electric efficiency and the greenhouse effect. Tuesday, Russell Mittermeir, president of Conservation International will be speaking on biological diversity in rain forests as part of the ongoing MillerComm90 Biodiversity Lecture Series. Wednesday, Dr. John Browder, Economics Professor of the Virginia Polytechnic Institute and State University will speak on the social dynamics of tropical deforestation. Thursday, Dave Newhouse, Regional Director of the National Audubon Society will speak on wetland protection.

On Saturday, there will be a one woman play, "Planting in the Dust," a recycling drive, a display of the environmental art and design competition entries, and a bicycle repair workshop. There will also be a recycling obstacle course, over 25 education and action booths, refreshments, speakers, and a number of local bands playing "Music for Mother Earth" in an all day concert. On Sunday, the community also has a number of activities planned.

For more information on the activities being planned for Earth Day, look for a calendar of events to be posted after April 7 or so. Also, messages can be left for SECS at the university YMCA at 337-1500. ■

-- Steven M. Frankel

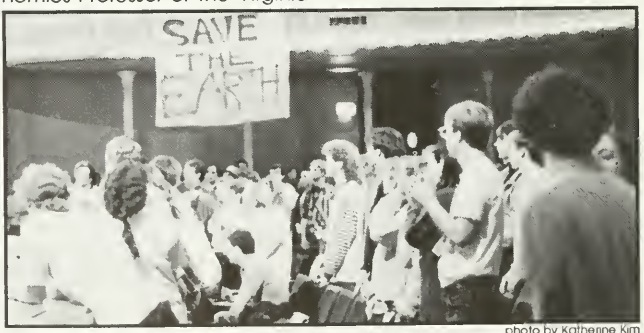


photo by Katherine Kim

Students at the University of Illinois attend an Earth Day rally at Foellinger Auditorium.

APRIL 16 MONDAY

"The Role of Ecologists in Solving Environmental Problems"
Presented by the graduate students of ecology, ethology and evolution
12pm 308 Natural History Building

Earth Day 1990 Kick-Off Ceremony
Sponsored by Students for Environmental Concerns
South quad in front of David Kinley Hall
1pm Tree Planting
1:30pm Chancellor Morton Weir address

Ecology Tour: Rail to Trail Prairie Project
David Monk, Coordinator of Heartland Pathways
(maximum of 30 participants)
2-4pm Meet at the University YMCA

"Electric Efficiency and the Greenhouse Effect: Projections and Responses"
Nick Lenssen, World Watch Institute
Ted Flanigan, Energy Program Director of the Rocky Mountain Institute
8-11pm Illini Union, Rooms A, B & C

APRIL 17 TUESDAY

Focus 580 with guest Russell Mittermier
Russell Mittermier, President of Conservation International
11am-12pm WILL radio (AM 580)

"Looking Ahead into 1990-91" *Know Your University series*
Morton Weir, Chancellor of University of Illinois
12-1pm Latzer Hall, University YMCA

Progressive Community Soup to Benefit Students for Environmental Concerns
11:30am-1:30pm Common Ground Food Co-op, Illinois Disciples Foundation, Springfield and Wright, Champaign

"Conserving Biological Diversity in the Tropical Rainforest: The Challenge of the 90's" *MillerComm90*
Russell Mittermier, President of Conservation International
8-10pm 112 Gregory Hall

APRIL 18 WEDNESDAY

"Solid Waste, Recycling and the Model Community"
John Thompson, Executive Director of the Central States Resource Center
12-1pm South Lounge Illini Union

Ecology Tour: Allerton Park Nature Walk
Gary Kling, Associate Professor of Horticulture, University of Illinois
(Maximum of 30 participants)
1-4pm Meet at north entrance of Illini Union

"A Prospect for Sustainable Agriculture: Energy Farming"
Sustainable Agriculture Spring 1990 Seminar Series
Folke Dovring, Professor Emeritus, Department of Agricultural Economics, University of Illinois
7:30-9pm K-2, University YMCA

"The Social Dynamics of Tropical Deforestation"
Dr. John Browder, Economics Professor, Virginia Polytechnic Institute and State University
8-10pm 228 Natural History Building

APRIL 19 Thursday

Ecology Tour: University of Illinois Composting Center and the Community Recycling Center
Rob Fletcher, Coordinator of the Yardwaste Reclamation site at the UI
Mark Laoughmiller, Director of the Community Recycling Center
Lissa Radke, Education Specialist of the Community Recycling Center
(maximum of 30 participants)
1-4pm Meet at north entrance of Illini Union

"Grassroots Wetland Protection"
Dave Newhouse, Regional Vice President of the National Audubon Society, Great Lakes Region
8-10pm Room 100 Noyes Lab

APRIL 20 FRIDAY

Ecology Tour: The Model Community Walking Tour
John Thompson, Executive Director of the Central States Resource Center
(maximum of 30 participants)
1:30-4pm Meet at Central State Office, McKinley Foundation, 5th and Daniel, Champaign

Earth Day 1990 Student Vigil: A passive protest against environmental destruction and social apathy
Sponsored by Students for Environmental Concerns
4pm Grassy triangle between Davenport Hall and Foreign Language Buildings

Ecology Tour: Earth Connection Gathering.
Tour a prairie restoration project, share a fingerfood potluck dinner around a bonfire and hear storytelling by John White, Ph.D., a native American Indian from the Ancient Lifeways Institute
6-9pm Barnhart Farm, 2 miles south of Urbana
Contact Don Barnhart, 684-2321

APRIL 21 SATURDAY

Earth Day 1990 Nature Expo
9am-5pm Market Place Mall, Champaign

Earth Day 1990 Festival
Sponsored by the Illini Union Board ans Students for Environmental Concerns. Environmental speakers, ecology plays, 30 education and action booths, recycling obstacle course, Music for Mother Earth Concert, refreshments, and the display of Environmental Art & Design competitions.
12-8pm South Patio, Illini Union

APRIL 22 SUNDAY

Earth Day 1990 Nature Expo
11am-5pm Market Place Mall, Champaign

Creation Ceremony: a Nondenominational Worship Service.
Central Illinois Children's Choir, songs and sermons by representatives of four faiths.
12-1pm Boat House, Crystal Lake Park, Urbana
Contact Chris Main, 356-3648

Community Earth Day Festival
Demonstrations, information booths, music, food and family fun
2-5pm Crystal Lake Park, Urbana
Contact Mary Hruska, 398-2768

Earth Day 1990 Benefit Concert
Poster Children and Backwards Day
9-11pm Mabel's, Urbana

Biodegradeable Plastics

Most plastics used today consist of carbon based polymeric chains that are durable, inert and non-biodegradable. While these properties are of great use in applications requiring long-term performance, they are unnecessary and sometimes even detrimental in applications in which the product is to be used for only a short period of time and then discarded. One of the main drawbacks in the latter case is that the discarded plastics retain the characteristic properties of the original product well after being disposed, increasing the volume of non-biodegradable products in landfills and garbage dumps. One of the solutions to this problem that is currently being explored is the development of a biodegradable form of plastic suitable for short-term applications.

Some of the more popular formulations being investigated are those which incorporate a carbohydrate into the structure of the polymer. The main effect sought here is the breakdown of the carbohydrate, leaving holes in the polymer which severely decrease the strength and elasticity of the original product. This weakened plastic is more easily broken down into smaller fragments that are less harmful to the environment.

The presence of the carbohydrate in the plastic also increases the probability that a macro-organism, an insect, for example, will find the composite palatable. In this process, the partially digested polymer is often broken down into smaller components (smaller carbon chains) that are more easily decomposed under the influences of normal environmental conditions. The breakdown of the plastic into smaller fragments also aids the process in that many insects attacking the plastic must do so at an edge.

Another mechanism by which polymer degradation occurs is through the utilization of chemical additives which when activated by sunlight, heat or other catalysts from the environment produce reactions that break down the polymers into smaller carbon chains.

> ***the breakdown of the carbohydrate (in the plastic) ... severely decreases the strength and elasticity of the original product.***

The most common method currently employed uses sunlight as a source of energy to drive the degradation; many companies employ this technology to produce plastic bags which are degradable. The drawback to this technological implementation is that the bags have to be exposed to the sun to be degraded, but most garbage is destined for landfills and dumps in which they are buried underground and not exposed to the sun. A promising alternative may be the use of catalyzed reactions that serve to break down the polymeric structure. One suggested mechanism involves the addition of oxidative materials that when brought into contact with common soil components produces a chemical that attacks the chemical bonds in the polymer chains, breaking it into smaller, more degradable carbon chains.

Some of the above applications are currently being researched here at the University of Illinois by Dr. Richard Wool, professor of Metallurgical Engineering, who has focused his work on the development of a biodegradable plastic based on polyethylene and cornstarch. The testing has covered such topics as the rate of removal of starch from samples, extent of occlusion of starch granules inside of the polymer, and the changes in the physical characteristics of the samples during degradation.

The rate of starch removal from a polymeric matrix was studied by placing samples of 40% starch composition in various types of soils and observing their degradation. The extent to which the starch within the samples decomposed was determined by the careful measurement of the evolution of carbon dioxide formed in the degradation reaction. It was found that all of the starch was removed from all of the samples within a period of ninety days, with some of the samples in sandy soils losing all of their starch within twenty days.

photo by Katherine Kim

Plastics are widely used in packaging such as in milk containers. Unfortunately, this plastic does not biodegrade rapidly and clutters the environment. One solution is to recycle; another is to find a biodegradable plastic.

The accessibility of the starch granules within the plastic was explored by modeling the polymer/granule system as a linear percolation problem. That is, the system was represented by a sea of polymer dotted randomly with the granules. The threshold at which most of the granules become accessible to microbial attack is at approximately 30% starch (less for thin films). The accessibility of the granules drops off precipitously below this amount, and thus the potential for full degradation drops off accordingly. The predictions of the model were tested by immersing samples of various starch compositions in an acid bath that digested the accessible starch but left the polymer behind. The amount of starch removed was determined by the mass change after digestion. The results of the experiment showed a marked increase in percent starch removed near a starch concentration of 30%, supporting the findings of the computer model. Furthermore, as predicted by the model, the samples of starch content in excess of 30% also exhibited decreases in elasticity and tensile strength of a far greater magnitude than those shown by samples of lower starch content.

These results and others lead the way to the development of a new era in plastics production that will include new composite materials created specifically for short-term use that will biologically or chemically degrade. Benefits from advances like this will be seen mostly be seen a decrease in the volume of necessary landfill to contain our garbage, but they will also include such advantages as the ability of plastic left in the environment to degrade so that it does not remain indefinitely as an eyesore and environmental hazard.

As of now, several institutions and companies are making use of photodegradable plastic bags for customer use or for retail, and several others are working on perfecting fully biodegradable lines of polymers that we may see being used in the next few years. ■

- - Kristin Ringland

photo by Katherine Kim

Clockwise from top: starch blend plastic films, oleic acid for chemical degradation, polyethylene, biodegradable polymer blend, corn starch, biodegradable polymer blend.

Surfacing Surface Science

Vaulting across the rolling terrain of interwoven orbitals, they speed their way ever closer to the treacherous, hole-ridden junction. Past obstructions of foreign matter, disruptions of the lattice, and stray bosons, they surge relentlessly toward their goal— drawn ever onward by some unseen force, they plummet helplessly to their demise. With a spray of quasi-particles and photons, they collide, scattering and metamorphosing- fulfilled or failed, they fade sans recognition, sans identity, sans purpose into the background radiation of the cosmos. Such is the life of a conduction electron in a semiconductor.

Semiconductors are applications of solid state and surface science. The surface scientist lives in a unique world. Instead of space and time, he lives in a realm of cycles, periodicity and frequency. Whereas the properties of a gas are derived principally from those of the individual particles, the properties of a solid are fundamentally based on its geometry. A crystal is distinguished by its translational symmetry; that is, in any given direction, the distance between two consecutive lattice points (atoms in an elemental crystal such as diamond) on a line is the same. The geometry may then be described in terms of the number of lattice points per unit length in each direction. This characterization has many practical advantages; this description is equivalent to expressing the Fourier transform of the lattice, so it behaves according to a vast catalog of theorems. Waves traveling through the crystal interact very strongly with the lattice if their direction and periodicity match that of the crystal. When detailed images of a crystal surface are obtained by diffraction, the image is not that of the "real" lattice, but rather that of the Fourier-transformed, or reciprocal lattice. Thus Fourier-space takes on an unprecedented physical reality.

Some Chemical Engineering undergraduate students at the University of Illinois who are interested in surface science applications are currently studying the interaction of light with gallium arsenide crystals. For this purpose, as for most, the crystal structure is not a principle actor, but rather is a non-Euclidean space in which the actors play. When a light enters a crystal, several things may happen. It may be reflected, it may be refracted, it may be absorbed, or it may pass through unscathed. Excepting the last case, the crystal must somehow be affected by these interactions. If an atom in the crystal should be set in motion, the result is a mechanical or vibrational wave that propagates across the lattice, so that the individual motion is lost to a macroscopic view. As Einstein referred to a package of light waves as photons, physicists refer to these mechanical waves (which compose heat and sound) as phonons. Alternatively, the light may impart en-

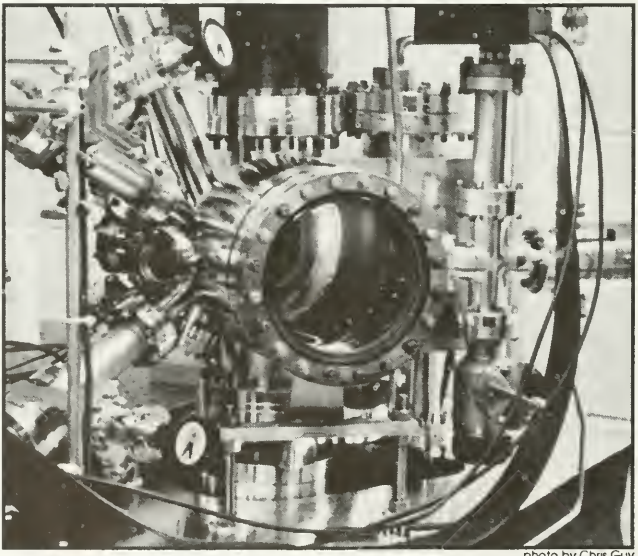
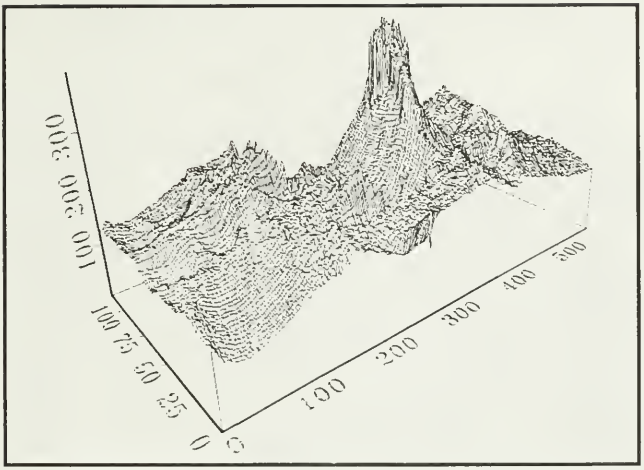


photo by Chris Guy

Vacuum chambers similar to this one are used in the study of surface science.



Surface science studies the microscopic surfaces of semiconducting materials and metals such as copper (pictured here).

ergy to an electron, which, unlike its companion nucleus, possesses sufficient wave-like character, and which may gain sufficient freedom to join with the photons and phonon in their journey across the lattice. Electrons so promoted are called conduction electrons and the minimum amount of energy required to promote one is called the band-gap energy. The band-gap energy plays an important role in determining the optical properties of the material.

The conduction electron leaves behind it a hole, which carries with it all the properties of a state in which an electron could be, but isn't. A positive hole and a negative electron bind together to form something vaguely akin to a hydrogen atom, called an exciton. Two excitons may then bond, as do hydrogen atoms. The functionality of semiconductors is based on the behavior of the quasi-gas trapped within the confines of the crystal lattice. It is the advancement of solid-state physics and surface science that has produced and sustained the present on-going revolution in electronics.

In addition, then, to solutions, gases and differently colored powders, the surface scientist must learn to live with fermions, bosons, excitons, particles of light, particles of heat, gases that aren't really gases, particles that aren't really particles, particles that are really the absence of particles, but which carry charge and having no mass bounce off obstacles, but they aren't anything but a place where an electron could be, but isn't. Pseudo-atoms, excitons, bound pairs; an electron and a "hole" orbit about one another as they trace their way through potential wells, excitons linking together forming pseudo-molecules. An adventure into fourier-space, into the microcosm of surface science and solid state physics is filled with weird and terrible sights and sounds, strange creatures of unrestrained character, heedless of our plain and predictable world.

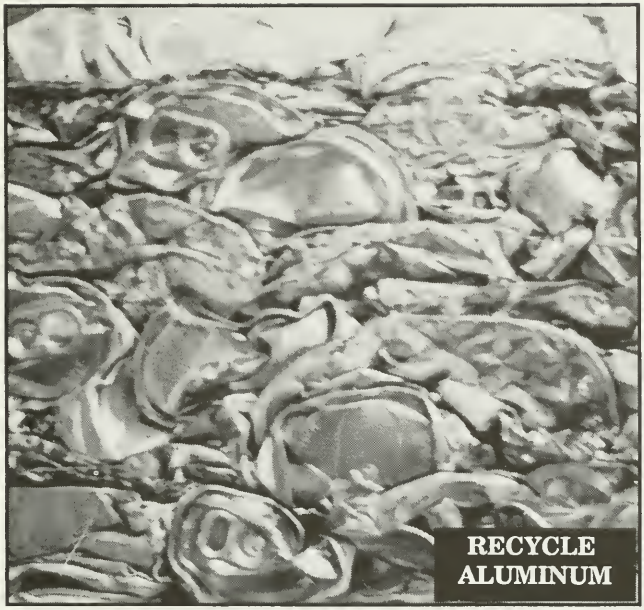
The surface scientist is concerned not so much with the crystal, nor with what is beyond the crystal, but with what happens when the crystal meets the beyond. Simple symmetries do not apply to this situation. Empty electron orbitals erupt from the surface like the fray of an unfinished garment. The geometry of this array of mathematical abstractions dictate both chemical and electromagnetic (optical) properties of the interface. This presence at the interface exerts its influence to some depth into the crystal, resulting in a boundary layer over which the material properties are not uniform. It is the effect of this boundary layer on photo- and electro-reflectance, or conversely, the characterization of this layer by spectroscopy, that our research team has been studying.

Reflectance spectra is modeled on a computer. The behavior of light at an ideal interface may be described in terms of the dielectric constant using Maxwell's equations. This constant is affected by the presence of an electric field and is consequently a function of the wave-length of the light in question. In addition, the unbonded orbitals at the surface tend to accumulate excess charge, which produces an electric field that diminishes to zero over the depth of the boundary layer. The models are based on a theory that predicts the effect of an electric field on the dielectric constant experienced by a particular wavelength of light. Since a charge in dielectric constant results in reflection, the entire boundary layer contributes to the spectrum. The exact solution to the problem is unknown, but by carefully simplifying approximations and numerical techniques, a variety of models are being developed and tested both here and around the world, as scientists and engineers push forward the frontiers of surface science. ■

-- Phil Jackson

THINK GLOBALLY

photo from DI Archives



photos by

Katherine Kim

ACT LOCALLY

Educating Engineers

The University of Illinois is well known for its engineering departments, both on the graduate and undergraduate levels. The 1987 Gourman Report, based on a survey of people in academia, placed the University of Illinois in the top ten in all but two of its undergraduate engineering departments. (See table for complete listing of survey results.)

The top rankings don't just happen. A great deal of work goes into planning the curricula and programs through which thousands of students will pass. Within a fairly rigid course structure of up to 132 hours, the College of Engineering must balance the demands for a broader general education background with the need to cover the ever increasing amount of technical material. At the same time, they must deal with the problem of the roles and relative importances of research, graduate and undergraduate programs.

One point of debate centers around the tug of war between more technical requirements and more general education requirements. There is increasingly more emphasis being put on a broader, more well rounded education, with increased exposure to the social sciences and humanities. The university is presently adopting a new set of general education requirements with these sorts of goals in mind. The effect of these new requirements on the engineering schools is not yet clear, but the addition of a foreign language requirement will probably be one of the changes implemented. Certainly the idea of a more diverse background seems to be a good one, but there is another side to all this as well. Technology is continually advancing, resulting in more and more material that needs to be taught. There is increasing pressure from the departments to include more technical material in the programs. Requiring more hours in either the liberal arts or the technical realm extends the program, which would probably meet with some resistance.

There are a variety of programs available to students allowing them to gain work, research and international experience. These programs strive to provide such opportunities by working within the basic curriculum without significantly increasing the course work necessary to graduate. As a general rule, courses are often revised to include recent technological advances so that they are as current as possible, and there are now special options in areas like bioengineering or polymer science.

For students seeking more than an engineering background, there is a combination engineering-LAS program which allows students to obtain degrees in both schools in 5 years. About 100 students take this option, many of them chosing an area such as economics or finance for their LAS degree, so that they are well prepared for management positions.

For those students who want an opportunity to practice what they are learning, there are work-study coops. About 300 students are involved in programs in which they alternate working for a semester and attending classes for a semester, allowing them to learn the necessary technical aspects of their field while gaining practical work skills and earning money. Some students gain practical experience staying on campus by working for a professor and helping with research projects. This gives them an idea of how the things they are learning can be applied and also shows them that there is more to their field than what is taught in classes.

The College of Engineering has realized the important role that international business and relations play in today's technology, and seeks to prepare interested students by offering an international minor in engineering. In this program, students select a specific non-English speaking country or geographic area and concentrate their studies in that area. They are required to complete a minimum of 21 hours of course work, including both study of the language and the culture of their chosen area. They must also spend at least eight weeks living and working or studying in their area. The College of Engineering has study exchange programs with universities in Argentina, Australia (where the emphasis is on Pacific rim countries), Brazil, China, Colombia, the Dominican Republic, France, Germany, Japan, Korea, Portugal and the USSR. The programs vary in length, depending on the universities,

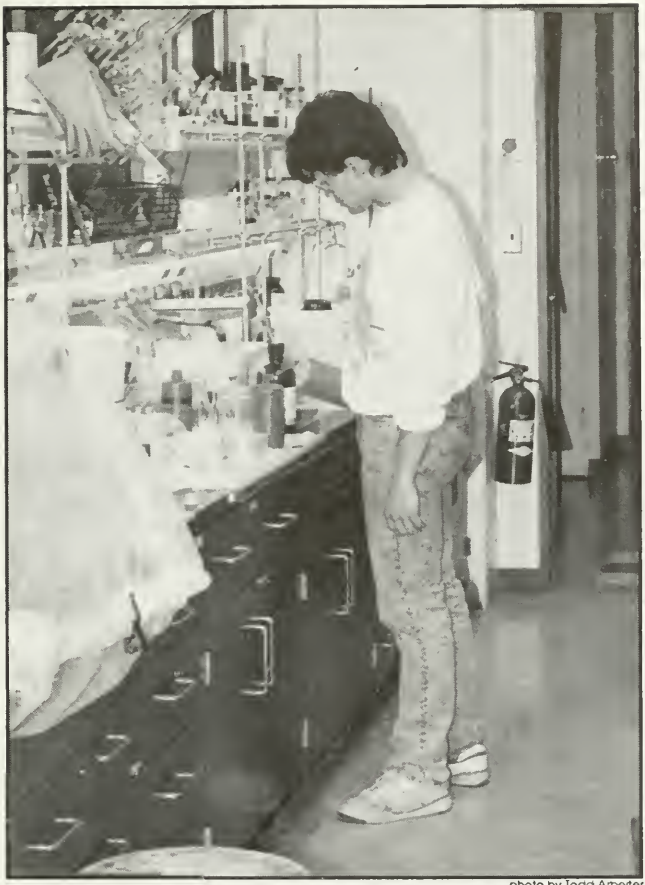


photo by Todd Arbeiter

Undergraduate research is one way students can apply the material they learn in the classroom to real life situations.

photo by Todd Arbeiter

A typical large lecture hall in the Loomis Laboratory of Physics.

and may run just for a summer or last through an entire academic year. Work exchange programs to the same areas are generally organized through the International Association for the Exchange of Students for Technical Experience (IAESTE). To encourage students to take advantage of such programs, the College of Engineering, through the Elmendorf World Citizenship Travel Awards, is able to help some students with travel costs to and from the work or study experience. Students who have participated in such programs find that their international experience makes them more desirable to companies when they interview.

There are of course numerous extra-curricular activities - like the Engineering Open House - which are open to students and which are also excellent ways for them to broaden their perspectives outside of the classroom or special programs. The student who is concerned with a broader background or experiences outside of the classroom will find that the College of Engineering 's special programs provide many opportunities.

Special programs cannot solve the very real dilemma of the role played by research at a large university. On one side, there is the undergraduate program and the need for well taught classes. On the other is the necessity of research for the large amount of funding and renown that comes with it. There will always be some conflict. Some faculty are strongly interested in research, and undoubtedly come to the University of Illinois for that purpose, and not to teach. All in all though, Dean Wenzel sees the research done by professors and the undergraduate program as mutually beneficial. "We wouldn't be what we are without that (research). Knowledge from the research and graduate programs filters down to the undergrads." Efforts are made to encourage good teaching. The College of Engineering emph[illegible]s both research and tea[illegible]ng in its promotion criteria. Various awards are offered for excellence in teaching. Every semester students evaluate their professors, and there is a peer evaluation process as well. Many of the professors enjoy teaching, and certainly the students benefit from professors' research experience. ■

-- Martha Tanner

UNDERGRADUATE RANKINGS BY DEPARTMENT

(source: The Gourman Report 1987)

AEROSPACE ENGINEERING

1. MIT
2. Michigan
3. Princeton
4. Minnesota
5. Illinois

AGRICULTURAL ENGINEERING

1. Cornell
2. Texas A&M
3. Iowa State
4. Michigan State
5. Wisconsin
6. Illinois

CERAMIC ENGINEERING

1. SUNY
2. Illinois
3. Ohio State
4. Iowa State
5. Missouri (Rolla)

CHEMICAL ENGINEERING

1. Minnesota
2. Wisconsin
3. California, Berkeley
4. Cal Tech
5. Stanford
8. Illinois

CIVIL ENGINEERING

1. California, Berkeley
2. MIT
3. Illinois
4. Stanford
5. Texas

COMPUTER ENGINEERING

1. MIT
2. California, Berkeley
3. Illinois
4. Michigan
5. Purdue

COMPUTER SCIENCE

1. MIT
2. Carnegie-Mellon
3. Berkeley
4. Cornell
5. Illinois

ELECTRICAL ENGINEERING

1. MIT
2. Stanford
3. California, Berkeley
4. Illinois
5. UCLA

GENERAL ENGINEERING

1. Illinois
2. Maryland
3. Oklahoma
4. Stevens
5. Colorado (Mines)

ENGINEERING MECHANICS

1. Columbia
2. Illinois
3. Wisconsin
4. Georgia
5. Cal Tech

INDUSTRIAL ENGINEERING

1. Stanford
2. Michigan
3. California, Berkeley
4. Purdue
5. Northwestern
15. Illinois

MECHANICAL ENGINEERING

1. MIT
2. Stanford
3. Berkeley
4. Minnesota
5. Princeton
11. Illinois

METALLURGICAL ENGINEERING

1. Illinois
2. Lehigh
3. Ohio State
4. Carnegie-Mellon
5. Penn State

NUCLEAR ENGINEERING

1. MIT
2. Michigan
3. Wisconsin
4. Berkeley
5. Virginia
7. Illinois

PHYSICS

1. Cal Tech
2. Harvard - Radcliff
3. Cornell
4. Princeton
5. MIT
9. Illinois

LIBRARIES

1. Harvard
2. Yale
3. Illinois
4. Columbia
5. Cornell

Tech-notes

An often heard complaint at large institutions such as the University of Illinois is that the education students receive is very impersonal. The complaint is not a surprising one considering that a professor must lecture to a room of 100 or more students.

The function of an academic advisor is to allow the student some one to one contact with the professor, but a problem similar to that of the large lecture hall also occurs. A professor must, in addition to advising undergraduate students, tend to his own research and graduate students, and he may not have the time to spend on the undergraduates.

Once in a while there is, however, a professor who puts forth an extra effort to help his undergraduate advisees. This professor will receive no extra grant money or accommodation for his efforts; rather, he invests the time because he cares about the students.

On the night of April 3, 1990, the Dean's Student Advisory Committee in conjunction with Arthur Anderson Consulting Company presented the second annual Advisor's Award Banquet to recognize these outstanding advisors.

The award was presented by William R. Schowalter, Dean of the College of Engineering to the following professors:

Joseph G. Bentsman (ME)
Sherman D. Brown (Ceramic)
James V. Canahan (GE)
Leslie Christianson (Civil)
Wayne J. Davis (GE)
Placid M. Ferreira (ME)
J. J. L. Higdon (ChE)
Anastasios Ioannides (Civil)
Chung Laung Liu (CS)
Douglas L. Marriott (ME)
Norman R. Miller (ME)
Ty A. Newell (ME)
David C. Bryant (GE)
John E. Prussing (Aero)
Umberto Ravaioli (CE)
David N. Ruzic (Nuclear)
Mark G. Strauss (GE)
Deborah L. Thurston (GE)
Tsa-Chin Tsao (ME)
John G. WIlliams (Nuclear)
Charles F. Zukoski (ChE)

Tech-teasers

Juan, a drug-runner from Columbia, is trying to transport 50 kilos of cocaine to Miami by boat. On the voyage there Biff, the Coast Guard spots him at a distance, a, and asks him to pull over. Luckily for Juan, a sudden fog rolls in. Unfortunately, he is not too intelligent since he is a graduate of the University of Michigan. He takes off straight in one direction. Biff knows that his boat is twice as fast as Juan's but he does not know in which direction Juan is travelling.

Fortunately for Biff, he is a graduate of the University of Illinois College of Engineering. He is a genius but has fallen upon hard times and has had to take a job as a coast guard to support his wife and ten children. He knows exactly how to catch Juan before he can deliver the cocaine and ruin countless young lives.

In what direction must Biff go to catch Juan?

answer on page 16

Tech-Profile: Phillip Geil

Professor Phillip Geil, Professor of Polymer Sciences in the Materials Sciences and Engineering Dept. at the University of Illinois, began his years in college as many college students do—without a clear idea of his future. Starting out in chemistry, Professor Geil worked his way through Wisconsin State College to attain his B.S. At the University of Wisconsin at Madison, he earned his Ph.D. in biophysics in 1957. As he looked for the job prospects, he was still unsure of his future. He decided to go to DuPont when he was offered a chance to join a fledgling polymer physics group which was investigating crystal structure similar to the organic molecular structure he had investigated in viruses. This was a more exciting portion of Geil's career, for he was allowed to do scientific research without being overly hindered to do something practical or to publish while he was there.

After 5 years at DuPont, Professor Geil followed up his first industrial experience with work at the Camille Dreyfuss Laboratory and Case Western Reserve University. He decided to move to the University of Illinois from Case because the U of I had a research grant about twice as large, and there were many more opportunities abound on the U of I campus.

In the ten years that Professor Geil has spent at the University of Illinois, he has stressed that polymer sciences should become an important part of the University curriculum. Geil currently plays a leading role in the push for an offering of a polymer science concentration. The University currently has no undergraduate program in polymers, but future existence of the concentration does look hopeful. He has even tried pushing for increased awareness of the importance of polymers outside of the university by convincing chemistry teachers at the high school and college level to include polymers in their chemistry programs. He insists that polymers are the wave of the future, especially in construction. Geil believes that steel will eventually be phased out as a construction material as polymers take its place. Even now, polymer additives are replacing steel in reenforced concrete.

> ***Geil believes that steel will eventually be phased out as a construction material as polymers takes its place.***

Professor Geil will continue to attempt to prod the University into what he sees as a new age of polymers. He does foresee a steady growth in the University program, but he believes that a science like polymers may outgrow anybody's attempts to catch up with it unless education in polymers everywhere improves. ■

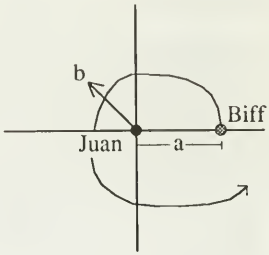
-- John Fultz

Correction EOH Guide 1990:

The EOH Central committee would like to thank Akila Srinivasan College Exhibit Chairperson for her time and help on EOH.

Tech-teasers answer

The answer is that Biff must travel in a spiral until he intersects with Juan. The spiral is given by the equations below:



$$v = \frac{dr}{dt}r + r^2\frac{d\theta}{dt}\theta$$

$$|v|^2 = \left(\frac{dr}{dt}\right)^2 + r^2\left(\frac{d\theta}{dt}\right)^2$$

For Juan:

$$|v_J| = b = \frac{dr}{dt}$$

$$|v_J|^2 = b^2 = \left(\frac{dr}{dt}\right)^2 \qquad \text{no } \theta \text{ dependance}$$

$$r = bt + c \qquad \text{since } t = {}^{a}\!/_{b} \text{ at } r = a$$

For Biff, the solution for $t \geq {}^{a}\!/_{b}$:

$$|v_B| = 2b$$

$$|v_B|^2 = 4b^2 = \left(\frac{dr}{dt}\right)^2 + r^2\left(\frac{d\theta}{dt}\right)^2$$

for $t \geq {}^{a}\!/_{b}$, $\frac{dr}{dt}$ = speed in r direction must match Juan's

$$\left(\frac{dr}{dt}\right)_B = \left(\frac{dr}{dt}\right)_J$$

$$(r)_B = (r)_J$$

$$4b^2 = b^2 + b^2t^2\left(\frac{d\theta}{dt}\right)^2$$

$$t\left(\frac{d\theta}{dt}\right) = \sqrt{3}$$

$$\theta = \sqrt{3}\ln(t) + c \qquad \text{since } \theta = 0 \text{ at } t = {}^{a}\!/_{b}$$

$$\theta = \sqrt{3}\ln\left(\frac{bt}{a}\right)$$

$$\theta = \sqrt{3}\ln\left(\frac{r}{a}\right)$$

$\therefore$ Biff must travel in a direction given by:

$$r = a\,e^{\theta/\sqrt{3}}, \quad \theta = \sqrt{3}\ln\left(\frac{r}{a}\right) \qquad \text{for } t \geq {}^{a}\!/_{b}$$

$$r = a, \quad \theta = 0 \qquad \text{for } 0 \leq t \leq {}^{a}\!/_{b}$$

to catch Juan.

We're sorry...

Since this is the last issue of the year, it is too late to join the Technograph staff.
However, it is not too early to join the 1990-91 Technograph staff!

Positions are always open for writers and photographers. Additionally, positions are open in business with opportunity for rapid advancement. We are also looking for an EOH editor to serve as a liaison to the Engineering Council.

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